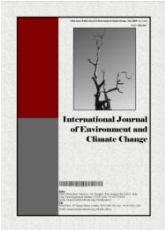

International Journal of Environment and Climate Change

12(11): 2310-2315, 2022; Article no.IJECC.91589
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Different Plant Growth Regulators on Fruit Yield and Quality Parameters of Cucumber (*Cucumis sativus* L.) cv. Punjab Naveen

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2022/v12i1131225

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/91589

Original Research Article

Received 29 June 2022
Accepted 07 September 2022
Published 09 September 2022

ABSTRACT

An experimental trial was carried out during the season from March 2018 – June 2018 at the Horticulture farm of Lovely Professional University, Phagwara (Punjab). utilising a randomised block design, the experimental trial consists three replications. The current study included eleven treatments, including a control with different PGR dosages of Maleic hydrazide (200, 250, and 300 ppm, MH), Naphthalene acetic acid (50, 100, and 150ppm, NAA), and Gibberellic acid (50,100 and 150 ppm, GA_3). Based on the results of the experiment, it was

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concluded that the treatment T_8 (100 ppm GA_3) significantly affected the cucumber's fruit yield parameters and treatment T_7 (50ppm GA_3) showed the better results in quality attributes Viz., TSS and fruit texture.

Keywords: GA_3; NAA; MH; growth; yield; quality; cucumber; Punjab Naveen.

1. INTRODUCTION

Among the many vegetables widely grown is the cucumber (*Cucumis sativus* L.), which belongs to the Cucurbitaceae family. An annual dioecious crawling vine, it covers itself in thin, spiral tendrils as it climbs trellises or other supports. The fruit of the plant is completely surrounded by broad-sized leaves. Fruit of the cucumber plant often has a tube form and extends to the ends.

Because of its low chlorine level, cucumber may also be utilised to manufacture a vegetable in addition to being used in pickles and salads. Also used as veggies are tender leaves. Fruits aid in the treatment of dyspepsia, jaundice, and constipation. Ayurveda employs seeds for a variety of purposes. Fruit and seeds both have cooling characteristics, making them useful as astringents and medicines. According to Mariod et al. [1], the seed oil contains four major fatty acids: linoleic acid (61.6%), oleic acid (15.7%), stearic acid (11.1%), and palmitic acid (10.7%), and the seed is extremely rich in nutritional compounds, including protein (33.8%), fat (45.2%), carbohydrates (10.3%), and crude fibers (2.0%). The fruits are very nutrient-dense, contain 95% water, and have very little calories (approximately 15 calories per cup) Mukherjee et al. [2].

Both fresh and processed cucumber are extensively consumed. Based on usage, it may be divided into three categories: salad, pickling, and cooking. In India and other countries, cucumber is mostly farmed for its fruits. Cucumber may flourish in a variety of soil types, including sandy, sandy loam, clay loam, and silt loam. Sand and sandy loam soil are used when an early crop is desired. In soil with a pH between 5.5 and 6.7, it grows best. A well-drained soil is ideal. Numerous physiological processes in cucurbitaceous plants can be altered by PGR, as is well documented [3]. According to Hilli et al. [4]. The use of GA_3 in combination with NAA stimulated plant metabolic processes by promoting vegetative development Gibberellic acid and NAA, when applied exogenously at the 2-4 true leaf stages, have a direct impact on sex expression, and it may be assumed that the metabolic activities of the cucumber plant are affected by the combined administration of GA3 and NAA.

The physiology of crops is impacted by plant growth regulators, which also enhance the plant's production characteristics. Maximum fruit production, maximum fruit weight (kg), and maximum yield per hectare (t) in cv. Fruit Long Green Cucumber were achieved by applying maleic hydrazide at a concentration of 100 ppm along with 100 ppm of ethephon [5]. In a different trial, the combination of GA3 20 ppm + NAA 100 ppm was advantageous for maximum fruit production, fruit weight (g), fruit yield per plant, and total yield per hectare (q) cv. "Pusa Uday" [6]. Applications of GA3 with NAA have stimulated metabolic activities in plants as a result of improving vegetative development, according to Hilli et al. [4]. Gibberellic acid and NAA applied exogenously at 2-4 true leaf stages have a direct impact on sex expression, and it may be assumed that the combined treatment of GA3 and NAA on cucumber plants participates in metabolic activities. The NAA substance in ridge gourds slows down cell elongation and cell division in meristematic shoots with various tissue types and regulates plant height without altering the plant's physiology or shape [4].

Growth regulators accelerated the commencement of female flowers in the current study, which may be related to an increase in auxin substance metabolization in plants and also a reduction in sugar, which changed membrane permeability Baruah and Sharma [7].

2. MATERIALS AND METHODS

The research experiment was carried out at the Horticulture farm of Lovely Professional University, Phagwara (Punjab). It was carried during the season from March 2018 – June 2018. The experimental trial conducted in Randomized Block Design with three replications.

Chart 1. The experiment included eleven different treatments

Sr. No.	Treatment notation	Treatments
1.	T_1	Foliar spray 50ppm NAA
2.	T_2	100ppm NAA
3.	T_3	150ppm NAA
4.	T_4	200ppm MH
5.	T_5	250ppm MH
6.	T_6	300ppm MH
7.	T_7	50ppm GA_3
8.	T_8	100ppm GA_3
9.	T_9	150ppm GA_3
10.	T_{10}	100ppm NAA+ 100ppm GA_3+ 250ppm MH
11.	T_{11}	Control

Each experimental unit was defined and layout was drawn as per plan. Punjab Naveen was the cultivar of cucumber which was planted at spacing of 2.5 m × 0.6 m during the experimental trial.

2.1 Parameters of Study

2.1.1 Fruit yield parameters

2.1.1.1 Fruit length (cm)

Fruit length was taken by the selected fruit with the use of Vernier calliper.

2.1.1.2 Fruit diameter (cm)

Fruit diameter was taken at three different places i.e., stalk end, middle end and floral end with the use of Vernier callipers and calculate the average diameter.

2.1.1.3 Number of fruits per plant

Fruit harvest from randomly selected the three plants when they are fresh and marketable purpose. Calculated the average of no. fruit ***/*** vine.

2.1.1.4 Average fruit weight (g)

Five fruits from each of the treatments were drawn randomly at time picking and their weight was added, the average of fruit weight was calculated by dividing them with the number of fruits.

2.1.1.5 Fruit yield per vine (Kg)

The weight of fruits from tagged plants in each treatment and each replication was reported on each picking and last picking of fruits, it was added to get the total weight of fruits from the tagged plants.

2.1.1.6 Fruit yield (q/ha)

Calculate the fruit yield per ha multiply the fruit yield plants by the total no. of plants on 1 ha.

2.1.2 Fruit quality parameters

2.1.2.1 TSS (Total soluble solid) ^{o}brix

TSS was determine with use of refractometer at the time of harvesting of fruit.

2.1.2.2 Texture of fruit

Recorded the texture of fruit by physically touch the surface of fruit. Divide into two categories-

- Smooth
- Rough

3. RESULTS

A statistical analysis of the data on various yield and quality parameters revealed a substantial outcome for cucumber.

3.1 Fruit Yield Parameters

3.1.1 Fruit length (cm)

The average length of fruits of different treatments was significantly influenced the fruit length compared to control. The fruit length was recorded maximum (18.84 cm) with exogenous application of T_9- GA_3 @150ppm and minimum (11.00 cm) with control.

The treatment T_9, T_6 and T_7were found statistically at par with T_9- GA_3 @150ppm.

3.1.2 Fruit diameter (cm)

The maximum fruit diameter (5.80 cm) was recorded under exogenous application of treatment T_7-GA_3 @50ppm whereas, the lowest diameter of fruits (3.20cm) was recorded in the $T1_1$-control.

3.1.3 Number of fruits per plant

The significantly maximum number fruits per plant (9.01) was recorded in the treatment T_8-GA_3 @100ppm and minimum (7.16) with T_{11}-Control. The treatments T_7 and T_1 are statistically at par with GA_3 @50ppm.

3.1.4 Average fruit weight (g)

A maximum average fruit weight was 258g recorded under the treatment T_8 GA_3 @100ppm and a minimum average fruit weight was 189.6g under T_4 MH@200ppm.

3.1.5 Fruit yield per vine (Kg)

The treatment shows significant increase in fruit yield per vine with foliar application of growth regulators as compared to control. The treatment T_7(GA_3@50ppm) recorded maximum fruit yield (2.17kg) as compared to control (1.65kg).

3.1.6 Fruit yield (q/ha)

The treatment shows significant increase in fruit yield per hectare with foliar application of growth regulators. The treatment T_8(GA_3@100ppm) recorded maximum fruit yield (218.33q/ha) and minimum in treatment T_{10}(NAA@100ppm+GA_3@100ppm+MH @250ppm) was 103.66 q/ha.

3.2 Fruit Quality Parameters

3.2.1 TSS (Total soluble solid) ^{o}brix

The significantly maximum T.S.S. was recorded in the treatment T_7-GA_3@50ppm valued 4.26 ^{o}brix followed by the treatment T_9- GA_3 @150ppm valued 4.16 ^{o}brix and T_8-GA_3@150ppm valued 4.15 ^{o}brix respectively. While, the minimum T.S.S. was recorded in the treatment T_{11}-control valued 3.11 ^{o}brix.

3.2.2 Texture of fruit

Texture of fruit of different treatment of cucumber is given in Table 1. Texture of fruit was categorized into smooth and rough fruit surface.

4. DISCUSSION

Maximum fruit length recorded in T_9- GA_3 @150ppm while the minimum length recorded in T_{11}- control. Due to effect of PGR reason for variation of length. According to Akhter & Rahman [8] application of GA_3 @75ppm has been recorded that maximum fruit length (18.50cm).

Maximum fruit diameter recorded in T_7- GA_3 @50ppm while the minimum fruit diameter recorded in T_{11}- control. Due to effect of PGR reason for variation of diameter. The various doses of GA3 @5ppm, @10ppm and @20 ppm and Maleic hydrazide @50ppm, @100ppm and @200 ppm) at various leaf stage (2,4 and 6) showed in increased diameter of fruit in cucumber of summer; whereas, Gibberellic acid was lesser to Maleic hydrazide**.**

Maximum no. of fruit per Vine was recorded in T_8- GA_3 @100ppm while the minimum no. of fruit per plant recorded in T_{11}- control. Due to effect of PGR reason for variation of no. of fruit per plant. Described that the higher no. of fruits per plant (15.8) given dose of 25ppm Gibbberellic acid [9]. Geeta et al. (2014a) conducted an experiment at Department of Crop physiology University of Agricultural Sciences, Dharwad and results reported that the bitter gourd crop no. of fruits /plant was significantly greater with foliar application of @ 20ppm Gibberellic acid (11.6%).

Maximum yield was recorded in T_8- GA_3 @100ppm while the minimum yield recorded in T_{11}- control. Due to effect of PGR reason for variation of fruit yield. According to Merentoshi et al. [10] stated that application of 50 ppm Gibberellic acid significantly increased all parameters of growth at later stages which in turn higher the yield (1.71 kg / plant).

Maximum TSS was recorded in T_7- GA_3 @50ppm while the minimum TSS recorded in T_{11}- control. Due to effect of PGR reason for variation of fruit yield. According to Shafeek et al. [11] increased TSS with doses of GA_3.

Fruit surface depend on the texture of fruit divided into smooth and rough. Treatment T_4 – Maleic hydrazide @ 200ppm and T_5- Maleic hydrazide @250ppm given smooth surface. In remaining treatments texture was rough.

Table 1. Effect of different plant growth regulators on fruit yield and quality parameters of cucumber (*Cucumis sativus* L.) cv. Punjab Naveen

Sr. No.	Treatments	Fruit length (cm)	Fruit diameter (cm)	Number of fruits per plant	Average fruit weight (g)	Fruit yield per vine (Kg)	Fruit yield (q/ha)	Total soluble solids (^{O}brix)	Texture of fruits
1.	Foliar spray 50ppm NAA	13	4.16	8.70	213.00	1.88	188.33	3.86	Rough
2.	100ppm NAA	14.55	4.01	8.55	218.00	1.86	185.00	3.94	Rough
3.	150ppm NAA	19.04	4.05	8.12	234.33	2.00	202.00	3.28	Rough
4.	200ppm MH	11.76	3.90	7.11	189.66	1.36	137.00	3.90	Smooth
5.	250ppm MH	15.60	5.96	6.92	191.00	1.35	136.66	3.60	Smooth
6.	300ppm MH	18.17	5.02	6.99	186.00	1.32	134.00	3.64	Smooth
7.	50ppm GA_3	16.76	5.80	8.81	204.00	2.00	203.66	4.26	Rough
8.	100ppm GA_3	16.27	5.58	9.01	258.00	2.17	218.33	4.15	Rough
9.	150ppm GA_3	18.84	5.66	8.51	206.66	1.89	190.00	4.16	Rough
10.	100ppm NAA+ 100ppm GA_3+ 250ppm MH	16.43	4.16	8.29	198.33	1.65	103.66	3.42	Rough
11.	Control	11	3.20	7.16	212.66	1.23	125.33	3.11	Smooth
	SEm (±)	**0.913**	**0.203**	**0.068**	**10.310**	**0.330**	**1.205**	**0.021**	**NA**
	C.D. at 5% of Level	**2.712**	**0.602**	**1.477**	**8.505**	**0.099**	**3.579**	**0.938**	**NA**

5. CONCLUSION

Based on the experimental trial's recorded data, it was possible to draw the conclusion that the treatment T_8(100 ppm GA_3) had a substantial impact on cucumber Fruit yield parameters viz., Number of Fruits Per Plant, Average Fruit Weight(g), Fruit Yield per Vine (Kg), Fruit yield (q/ha). Treatment T_7 GA_3(50ppm) and Treatment T_9 GA_3(150ppm) showed the maximum fruit diameter and fruit length respectively. So, it is advised to cucumber growers to spraying GA_3(100ppm) for obtaining better yield and quality of cucumber.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/91589